

## Exhibit III Mars Environment

### Martian gravity

The gravity on Mars is  $3.727 \text{ m/s}^2$ , about 38% of the terrestrial value.

### Martian materials

Materials likely to be encountered range from dense basalt to poorly consolidated basaltic sands. The presence of mixed ice and rock is also likely.

Examples of materials that can be used for this study:

Rock type	Bulk density g/cm <sup>3</sup>	Hardness	Compressive Strength N/m <sup>3</sup>	Young's Modulus N/m <sup>2</sup>
Dense basalt	2.74	49-85	1.13-1.32	5.21-7.65
Sandstone	2.69	20-65	1.02-9.79	1.01-9.58
Ice saturated breccia		102	1.65-8.28	7.79

Hardness = relative hardness

Compressive strength = load bearing capacity according to Mohr failure concept

Young's modulus = the fundamental stress-strain relationship; triaxial compression

### Martian environment

#### Martian Atmospheric Composition

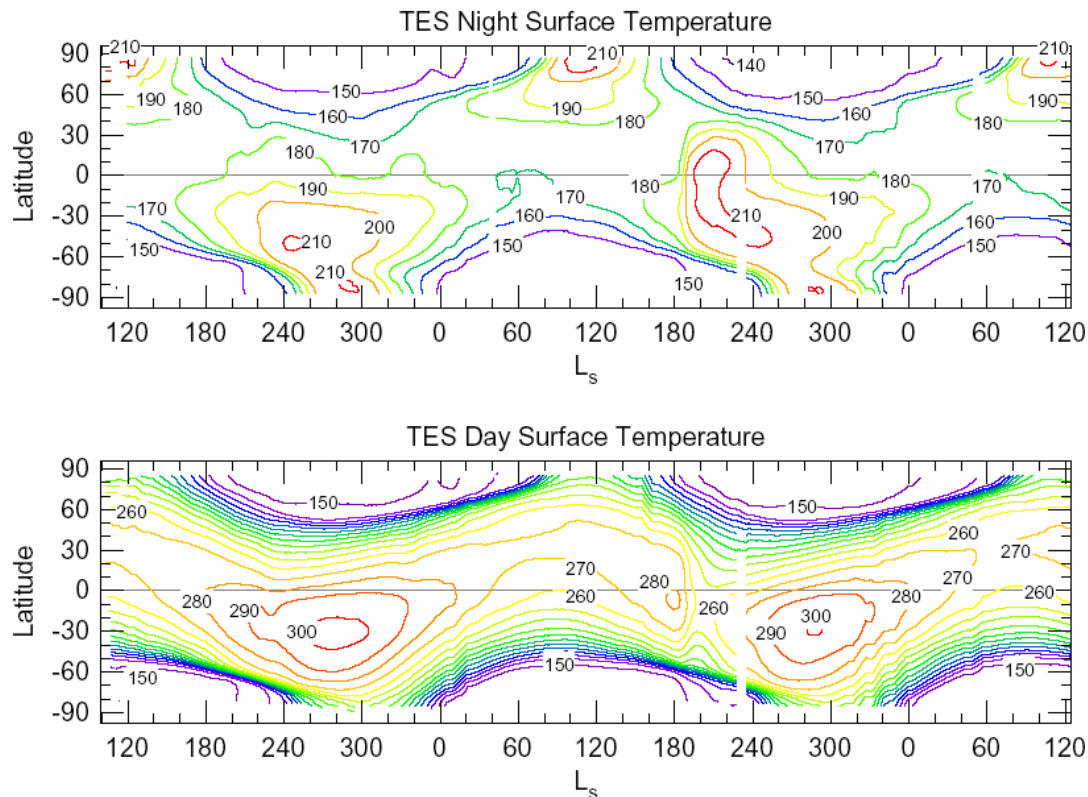
The main components and characteristics of Mars atmosphere are provided in the table below. Note that both CO<sub>2</sub> and water will condense out of the atmosphere at certain seasons and locations. This may occur as either a surface frost or as "snowfall."

**Table 1 Mars atmospheric characteristics and comparison with Earth similar components**

Components		Mars	Earth
Atmosphere composition		%	
Carbon dioxide	CO <sub>2</sub>	95.3	0.03
Nitrogen	N <sub>2</sub>	2.7	78.1
Argon	Ar	1.6	0.93
Oxygen	O <sub>2</sub>	0.13	20.9
Carbon monoxide	CO	0.07	0.000007
Water	H <sub>2</sub> O	0.03 ( <u>highly variable</u> )	1.0
Atmosphere characteristics			
Mean molar mass	g mol <sup>-1</sup>	43.49	27.8
Atmospheric density	Kg/m <sup>3</sup>	$1.55 \times 10^{-2}$	1.23
K = R/Cp		0.257	0.2857
Pressure at level 0	hPa (mbar)	5-8	1013
Equilibrium temperature	K	210	256
Scale of mean thermodynamic height	km	10	7.8

### Maximum and Minimum Surface Temperatures

The seasonal and latitudinal dependence of surface temperature is portrayed by Fig. 2. The data refer to 2 AM and 2 PM and offer approximations to the daily minima and maxima. The data are averaged over all longitudes, so do not show the full range of temperature. The minimum temperature at the surface is near 148 K, the condensation point for CO<sub>2</sub> at 6 mbar pressure. Frost forms at night when this temperature is reached, and at high latitudes in winter this situation may occur continuously. The Mars Very Deep Drill latitude range would include places where such temperatures occur for months on end, particularly in the south.



**Fig. 2. Martian surface temperatures at 2 AM and 2 PM, derived from MGS Thermal Emission Spectrometer data by M. Smith. These data have been averaged across all longitudes. ( These data were prepared personally by M. Smith from MGS TES data released to the Planetary Data System, and available from the PDS Geosciences node.)**

The maximum temperature occurs for low thermal inertia regions near the subsolar latitude in southern summer. The northern summer is not as hot because Mars is then considerably farther from the sun, due to the elliptical orbit. The hottest latitude is slightly south of the subsolar extreme because the duration of daylight is also important. At such latitudes ( $-30^{\circ}$ ), a low inertia surface could exceed 310K. However, these latitudes are primarily of higher inertia, and so the 300K contour seen in Fig. 2 is a good generalization for that latitude region.